# IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
## BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

| | | |
|---|---|---|
| Applicants | : | Masuhiro Natsuhara et al. |
| App. No. | : | 10/708,224 |
| Filed | : | February 18, 2004 |
| Title of Invention | | Wafer Holder for Semiconductor Manufacturing Device and Semiconductor Manufacturing Device in Which the Holder Is Installed |
| Examiner | : | Sang Yeop Paik |
| Art Unit | : | 3742 |

## APPEAL BRIEF

Honorable Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This brief on Applicants' appeal follows the Notice of Appeal filed September 8, 2006 in the above-identified patent application, and is attendant on the decision, issued November 27, 2006, by the panel conducting the Pre-Appeal Brief conference requested in Applicants' Pre-Appeal Brief Request for Review filed on even date with the Notice of Appeal. The panel's decision was that there is one actual issue for appeal.

Respectfully submitted,

December 27, 2006

/James Judge/

James W. Judge
Registration No. 42,701

**JUDGE & MURAKAMI IP ASSOCIATES**
Dojima Building, 7th Floor
6-8 Nishitemma 2-Chome, Kita-ku
Osaka-shi 530-0047
JAPAN

Telephone: **305-938-7119**
Voicemail/Fax: **703-997-4565**

**Table of Contents**

(i) Real Party in Interest . . . . . page 3

(ii) Related Appeals and Interferences . . . . . page 4

(iii) Status of Claims . . . . . page 5

(iv) Status of Amendments . . . . . page 6

(v) Summary of Claimed Subject Matter . . . . . page 7

(vi) Grounds of Rejection to Be Reviewed on Appeal . . . . . page 9

(vii) Argument . . . . . page 10

(viii) Claims Appendix . . . . . page 12

(ix) Evidence Appendix . . . . . page 13

(x) Related Proceedings Appendix . . . . . page 14

## (i) Real Party in Interest

The real party in interest is Sumitomo Electric Industries, Ltd., the assignee of record and the mailing address of which is: 5-33 Kitahama 4-chome, Chuo-ku, Osaka-shi, Osaka Pref. 541-0041, Japan.

## (ii) Related Appeals and Interferences

No related appeal or interference proceedings have been undertaken in the present application.

## (iii) Status of Claims

Claims 1 through 4 stand rejected by the Office action dated March 8, 2006 and made final, in the once-continued examination of the present application. Claims 1-4 were the total claims presented on filing the application. Claim 1 was amended twice during the course of the original examination, in response to first and final actions by the Office. Claim 1 has not been further amended, neither in response to the first nor to the final action in the continued examination. Claims 2-4 remain in their original form as filed.

## (iv) Status of Amendments

Subsequent to the March 8, 2006 Office action, no amendments have been filed.

## (v) Summary of Claimed Subject Matter

The subject matter defined in claim 1, the lone independent claim in the present application is a device known as a wafer holder or wafer heater, but also referred to as a susceptor, employed for chucking and heating the wafer-like substrates on which semiconductor devices are fabricated. The "substrate" recited in claim 1 is a "ceramic sinter laminate" manufactured as described in paragraphs [0018] through [0045], and paragraphs [0047] through [0052] of the specification. As described in the exemplary embodiment, the substrate is a discoid block 340 mm in diameter (*L*) and 20 mm in thickness. This substrate will hereinafter be referred to as a "susceptor block."

The susceptor block is mounted on a shaft. In the terminology of claim 1, the front side of the susceptor block is a wafer-carrying side, while the back side is a shaft-joining side. The shaft-joining side of the susceptor block has a predetermined planarity and surface roughness, as does the joint surface of the shaft. Specifically, the planarity is 0.5 mm or less; the surface roughness 5 $\mu$m or less in Ra.

The shaft is made of a substance whose difference in thermal expansion coefficient with the substrate is $5 \times 10^{-6}$ K or less.

As noted in paragraph [0015], the shaft may be cylindrical in form. As a shaft, the susceptor-block support component defines a center axis. In the terminology of claim 1, the distance between the center axis of the shaft and the axial center of the wafer-carrying side of the susceptor block is ***a***, as indicated in the lone figure. The shaft is joined to the shaft-joining side of the susceptor block such that the distance ***a*** is 5% or less of the diameter ***L*** of the wafer-carrying side.

These preconditions on the susceptor block, on the susceptor-block support shaft, and on the positional relationship between the susceptor block and the support shaft lead to the unexpected, novel result that the temperature distribution in the wafer-carrying side of the working susceptor is held within ±1.0%.

The invention as defined in claim 1 involves the realization that in a working susceptor—that is, in a susceptor that is heating a wafer that the susceptor carries—a uniformity-disturbing temperature distribution arises because the temperature drops at the susceptor periphery and over the shaft. And in light of that realization, the invention as defined in claim 1 involves the discovery that if the distance ***a*** is 5% or less of the diameter ***L*** of the wafer-carrying side of the susceptor, then *the temperature distribution arising from the central and*

*peripheral temperature losses in the susceptor wafer-carry side will be no greater than ±1%.*

As noted in paragraphs [0015] and [0016] of the specification,

> The temperature of a ceramic susceptor directly over the shaft joint drops in a pattern on the wafer-carrying side that is more or less the same shape as the shaft. For example, if the shaft is shaped as a round cylinder, then in a concentrically round shape an area where the temperature drops will appear. The temperature of the peripheral portion of wafer-carrying side also tends to drop, because heat radiates from the circumferential surface. The consequence for the wafer-carrying side is that the temperature of the area directly over the shaft and in the vicinity of the periphery drops, heightening the temperature adjacent the interval between the direct-over-shaft area and the periphery environs, which creates a temperature distribution in the wafer-carrying side.
>
> Thus the more displaced are the center axis of the shaft and the axial center of the wafer-carrying side, an area will form where the longer will be the distance between the shaft and the periphery of the wafer-carrying side; the temperature differential in the wafer-carrying side in that area will be maximal. Enlargement of the temperature differential in the wafer-carrying side enlarges the temperature differential in the surface of a wafer being carried.

Given the foregoing realization, the discovery at the heart of the invention recited in claim 1 is that the temperature drop progressing outward from the center, and the temperature drop progressing inward from the periphery balance (cancel each other out) to achieve a temperature distribution of within ±1% if the distance ***a*** between the center axis of the shaft and the axial center of the wafer-carrying side of susceptor block is 5% or less of the diameter L of the wafer-carrying side.
The subject matter of claim 1 may also be conceived of as the discovery that there is a range of manufacturing tolerance for attaching the shaft to the susceptor block that is acceptable to achieve a temperature distribution of within ±1%. This is a valuable discovery to a manufacturer such as the real party in interest in the instant application.

## (vi) Grounds of Rejection to Be Reviewed on Appeal

The lone rejection of the claims 1 through 4 is under 35 U.S.C. § 103(a) over a single reference, U.S. Pat. No. 6,071,465 to Kobayashi, presumably in combination with knowledge of those skilled in the susceptor arts.

## (vii) Argument

Appellants submit that the Examiner's *prima facie* case in support of the rejection under 35 U.S.C. § 103(a) over U.S. Pat. No. 6,071,465 to Kobayashi—which rejection was repeated verbatim from the Office action of September 20, 2005 and made final in the continued examination—is deficient for at least two reasons: lack in the factual basis; and error in the reasoning.

The Examiner has not presented factual evidence that aligning "the center of the supporting shaft (. . .) with the center of the substrate"—as the Examiner alleges is shown in the figures of Kobayashi—leads to a device that *completely* meets the limitations of claim 1 of the present application. Specifically, the Examiner has not pointed to any showing in Kobayashi that distance between the axial center of the wafer-carrying side of the "disk-shaped base 37" of the heating apparatus illustrated in Fig. 10 (the only relevant figure) of Kobayashi, and the axial center of the "tube-shaped body 35" is 5% or less of the diameter of the wafer-carrying side.

Granting that the motivation that the Office gives to combine references, or a lone reference with a skilled artisan's knowledge, need not match the motivation that inspired the inventors, Appellants submit that the Examiner has failed to demonstrate that the motivation the Examiner mentions would in fact lead to a combination that meets each and every limitation of Appellants' claim 1—and most specifically, the limitation just quoted. The Examiner has merely made a general statement that Kobayashi shows "that the center of the supporting shaft is aligned with the center of the substrate" and that a person skilled in the art would have been motivated to have the alignment be "within the claimed range to prevent imbalancing of the substrate on the supporting shaft." *Yet the Examiner has failed to demonstrate how the Kobayashi device, thus modified "to prevent imbalancing" would meet Appellants' claim 1 limitation with regard to the wafer-carrying side of a wafer holder.*

Although the distance ***a*** can be zero, nowhere does the specification teach or suggest that the goal of the present invention is to center the substrate on the shaft; indeed the shaft center axis is correlated to the axial center of the *wafer-carrying side*—not the back side where the shaft is joined—of the susceptor block. Centering would entail relative dimensioning between the susceptor block as a whole, and the shaft.

Accordingly, ***a*** is dependent on the diameter of the susceptor wafer-carrying side alone; a susceptor with a sloped circumferential side would allow more or less tolerance in where the shaft is joined to the shaft-joining side depending

on which side—the wafer-carrying side or the shaft-joining side—is greater in diameter. And it is to be noted that ***a*** is *not* dependent on the size, nor even the contour, of the shaft; nor is ***a*** is a dependent on the thickness of the susceptor.

Furthermore, under Response to Arguments in the final Office action, the examiner states

> Kobayashi[,] realizing the importance of having . . . proper machined surfaces and the flatness of the device that is in a micro scale[,] would have been further motivated to achieve a stable balance of the substrate with respect to the shaft to ensure a desired heating distribution along the heating surface.

Notwithstanding the above-quoted comment by the examiner, Appellants submit that the examiner is applying hindsight reasoning, and that consequently the examiner has not made a proper *prima facie* case of the obviousness of claim 1 over the Kobayashi reference (in combination with the common knowledge of those skilled in the art).

That is, in addressing the surface limitations recited in claim 1 of the present invention, the examiner uses hindsight reasoning in making his statements about Kobayashi "realizing the importance of having . . . proper machined surfaces and the flatness" in the relevant components of his device, and being "motivated to achieve a stable balance of the substrate with respect to the shaft to ensure a desired heating distribution along the heating surface."

Therefore, Appellants submit that such hindsight reasoning constitutes a factual deficiency in the examiner's rejections.

## (viii) Claims Appendix

**Claim 1 (currently amended):** For a semiconductor manufacturing device, a wafer holder comprising:

a substrate having a wafer-carrying side and a shaft-joining side, said shaft-joining side lent a planarity of 0.5 mm or less, and a surface roughness of 5 $\mu$m or less in Ra; and

a substrate-supporting shaft having a substrate-joining face lent a planarity of 0.5 mm or less, and a surface roughness of 5 $\mu$m or less in Ra, and being of a substance whose difference in thermal expansion coefficient with the substrate is $5\times10^{-6}$ K or less, said shaft joined to said shaft-joining side of said substrate such that a distance ***a*** between the center axis of said shaft and the axial center of said wafer-carrying side of said substrate is 5% or less of the diameter ***L*** of the wafer-carrying side, whereby the temperature distribution in the wafer-carrying side of said substrate is within ±1.0%.

**Claim 2 (original):** A wafer holder as set forth in claim 1, being a ceramic susceptor including at least a resistive heating element.

**Claim 3 (original):** A semiconductor manufacturing device in which a wafer holder as set forth in claim 1 is installed.

**Claim 4 (original):** A semiconductor manufacturing device in which a wafer holder as set forth in claim 2 is installed.

## (ix) Evidence Appendix

- None -

## (x) Related Proceedings Appendix

- None -